PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

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NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Rule 71.1)

Date of mailing *(day/month/year)*	18.04.2005
Applicant's or agent's file reference	IMPORTANT NOTIFICATION
P61.143PC00	

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/NL 03/00937	24.12.2003	24.12.2002

Applicant
OTB GROUP B.V. et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

The applicant's attention is drawn to Article 33(5), which provides that the criteria of novelty, inventive step and industrial applicability described in Article 33(2) to (4) merely serve the purposes of international preliminary examination and that "any Contracting State may apply additional or different criteria for the purposes of deciding whether, in that State, the claimed inventions is patentable or not" (see also Article 27(5)). Such additional criteria may relate, for example, to exemptions from patentability, requirements for enabling disclosure, clarity and support for the claims.

Name and mailing address of the international preliminary examining authority:	Authorized Officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Hopwood, S Tel. +49 89 2399-2429

Form PCT/IPEA/416 (January 2004)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P61143PC00	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/NL 03/00937	International filing date *(day/month/year)* 24.12.2003	Priority date *(day/month/year)* 24.12.2002
International Patent Classification (IPC) or both national classification and IPC H01L27/00		
Applicant OTB GROUP B.V. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of ~~17~~ 16 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
23.07.2004	18.04.2005
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Cockcroft, Y Telephone No. +49 89 2399-2436

Form PCT/IPEA/409 (Cover Sheet) (January 2004)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/NL 03/00937

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

1-11/0 received on 23.02.2005 with letter of 21.02.2005

Claims, Numbers

1-45 received on 23.02.2005 with letter of 21.02.2005

Drawings, Sheets

1/20-20/20 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	
	No:	Claims	1,31,45
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1,31,45
Industrial applicability (IA)	Yes:	Claims	1-45
	No:	Claims	

2. Citations and explanations

   see separate sheet

Clarity and Interpretation of Claims on File

There are a number of clarity objections to be raised against the claims on file (Article 6 PCT).

Features following the terms "such as" and/or "for instance" do not restrict the claims in any way and are superfluous. These features cannot be taken into account during examination of the novelty and inventive merit of the claimed subject matter. They should be deleted or included in further dependent claims as true restrictions of the subject matter of preceding claims.

It is not apparent what is meant by the term "shadowing structure". This has thus been interpreted as being any structure in the substrate which can, at least in some situations shadow areas of the substrate.

According to lines 11-12 of claim 1 the conductive layer need not be present at all on parts of the shadowing structure. However, according to line 14 of the claim the resistance is greater in these parts than in "the rest of the conductive layer" which implies that the conductive layer must also be present in the parts of the shadowing structure.

A number of features of claim 1 are superfluous and should be deleted. Any electroluminescent material will emit light under the influence of a voltage, and any substrate has a surface which forms a boundary for layers to be formed thereon. [Even a planar substrate has a surface (its edge) which is a boundary for some layers thereon.] These features do not restrict the subject matter of the claims in any way.

It is not apparent how the first conductive layer of claim 1 is related to the first and second conductors of the claim. It is clear on reading the description that this first conductive layer actually forms the first conductors and claim 1 has been examined using this interpretation.

There is no indication in claim 8 as to where on the substrate and when in the method of claim 1 the pixel pits are formed and how they relate to the other structures and layers of the claimed method.

The suggestion in claim 19 that the shape of the surface structures is "adapted by a

transforming technique" is not clear. Firstly there is no indication as to what shape or form the surface structure is to have initially, secondly there is no indication why it is to be adapted, or to what it is to be adapted and finally the term "transferring technique" can cover almost any process since all processes will transform something in some way. (For example merely depositing another layer will adapt the surface structure by a transforming technique.)

A substrate cannot be defined in terms of the use to which it is to be put, nor by any method steps which may be performed on said substrate. Independent claim 31 thus has to be considered as for a plastic substrate which could be used to form an OLED and which has a surface structure which will allow a conductive layer to be formed on some parts of the structure more thickly than on other parts of the structure. Any substrate which has such a structure will destroy the novelty of claim 31, irrespective of whether the substrate is ever used for an OLED or indeed whether any conductive layer is ever formed thereon.

The feature in claim 35 that the surface structure is releasing is not understood.

Since it is not possible to define in a substrate by the method used for its manufacture, claim 36 does not define any feature of the substrate of claim 31.

A device cannot be defined in terms of its method of manufacture as already indicated above. Therefore, claim 45 has to be considered as claiming an OLED formed on a substrate with a structured surface and having two conductive layers with an organic electroluminescent material between them at crossing points thereof. Any known substrate having these features will destroy the novelty of claim 45 irrespective of how the known device has been formed.

To Point V

Insofar as the subject matter of claim 1 can be understood, it appears to lack novelty compared to the teaching of the prior art.

Document D1 shows a method of manufacturing an organic electroluminescent device

(paragraph 0001) wherein an arrangement of layers is applied to a substrate such that first conductors extend in a first direction and second conductors extend in a second direction, while between crossings of the first and second conductors an organic electroluminescent compound has been provided which under the influence of a voltage emits light (see figure 2 and the corresponding text). The substrate of D1 is plastic (paragraph 0024) and has a surface structure which forms a boundary for at least a number of the layers which are applied (paragraphs 0025 and 0026) It is noted in this respect that this portion of claim 1 of the current application is not restricted in any way to a layer being contained within this boundary immediately after a layer application process, but simply that in the final device at least one of the applied layers is within the boundary. Clearly the indentations of D1 provide a boundary in the final device for the first conductive layer which is applied.

The surface structure of the plastic substrate of D1 is moreover provided with a shadowing structure which is such that with the layer application process parts of this structure are not covered with the respective conductive layer (in D1 it is the upper sidewalls of the indentations which are not covered with the conductor layer), the shadowing structure being such that the electrical resistance prevailing there is great relative to the resistance in the conductive layer (clearly the exposed plastic sidewalls of the substrate of D1 will have a greater resistance than the electrode material deposited in the indentations).

The claimed method is also seen in document D2 (see paragraphs 0029, 0030 and 0032) which shows a similar structure to that of D1 with indentations and an electrode layer formed in the indentations.

The method of D1 and D2 each contains all the features of claim 1 as far as the claim can be understood. Claim 1 does not satisfy the requirements of Article 33.2 PCT.

D1 and D2 clearly disclose a plastic substrate suitable for manufacturing an OLED, the substrate having a surface structure forming a boundary for at least a number of the layers to be applied such that parts of this structure are not covered with one of the conductive layers of the OLED. These uncovered parts have an electrical resistance that is great compared to the resistance in the rest of the conductive layer.

Claim 31, taking account only of the subject matter which relates to a substrate and disregarding the subject matter relating to method steps, does not contain any features not

explicitly known from D1 and D2. The claimed substrate lacks novelty compared to the teaching of either of these documents and claim 31 does not comply with Article 33.2 PCT.

Since both D1 and D2 are concerned with organic electroluminescent devices formed by a method as in claim 1 of the application, using a substrate as in claim 31, then the devices must be identical to those covered by a clarified claim 45. The requirements of novel subject matter according to Article 33.2 PCT are not met by claim 45.

P61143TW00

Title: Method for manufacturing an organic electroluminescent display device, substrate to be used with such a method and an organic electroluminescent display device obtained with the method.

The invention relates to a method for manufacturing an organic electroluminescent display device, wherein an arrangement of layers is applied to a substrate, such that, in a first direction, conductors extend, as well as second conductors in a second direction, while between crossings of the first and second conductors, an organic electroluminescent compound is provided which emits light under the influence of a voltage.

The invention also relates to a substrate suitable and intended for use in a method according to the invention for manufacturing an organic electroluminescent display device, the method comprising the step of applying a first conductive layer by means of a layer application process.

With the known method for manufacturing an organic electroluminescent display device, the starting point is a substrate manufactured from glass, onto which a structure has been applied with the aid of a photoresist, provided, for instance, through spin coating, which photoresist has been locally exposed and thereupon has been locally removed with washing techniques. These processes are laborious, cost much time and hence are costly. As, in the manufacture of displays, it is the very cost price which plays a predominant part, the provision of a display device wherein such "wet" chemical steps for manufacturing the display device are omitted would be of great advantage.

To this end, according to the invention, the method of the type described in the opening paragraph is characterized in that the substrate is manufactured from plastic and has a surface structure which forms a boundary, at least for a number of the layers which are applied, a first conductive layer being applied by means of a layer application process, the surface structure of plastic substrate being provided with a shadowing

structure which is such that with the layer application process, parts of this shadowing structure are hardly covered, if at all, with the respective conductive layer, the shadowing structure being such that the electrical resistance prevailing there is great relative to the resistance in the rest of the conductive layer.

Such a plastic substrate which is provided with a surface structure can be manufactured with a plastic formation process known per se such as, for instance, injection molding, embossing, photopolymeric replication or the like. Embossing has been described in, for instance, US-A-4 659 407, photopolymeric replication has been described in WO 87/02934. From, for instance, the manufacture of CDs, injection molding techniques are known with the aid of which very fine submicronstructures can be manufactured in a plastic substrate at relatively very low cost prices. The need of using wet chemical techniques for forming the substrate is thereby cancelled with all associated advantages. Such fine surface structures can also be applied on a film, as is described in, for instance, WO 99/12160 or EP-A-0 408 283.

According to a further elaboration of the invention, the shadowing structure can comprise a number of parallel, narrow and deep grooves, while the width and the depth of the grooves are such that, in the layer application process, at least a part of the side walls and/or the bottom of these grooves is hardly covered, if at all, with the first conductive layer.

Such a groove structure can be designed to be such that, in a releasing manner, it can be taken from the mold in which the plastic substrate is formed. In the formation process of the plastic substrate, the shadowing structure is provided without, to that end, one single finishing step being required for the plastic substrate. Basically, the shadowing structure is obtained practically free of charge in the formation process of the plastic substrate when the mold has the right shape.

According to still another elaboration of the invention, layers can be applied with the aid of a printing operation such as, for instance, inkjet printing, silkscreen printing, electrostatic printing techniques and thermal transfer printing. In order to somewhat simplify the printing process, it can be advantageous to design the surface structure of the substrate to be such that, as it were, channels have been provided herein in which the liquids dispensed through the printing process are deposited. The walls of the respective channels form the boundaries of the liquid deposited in the channels with the printing process.

Subsequently, with printing techniques, layer application techniques such as sputtering, CVD and PECVD-techniques, layers and layer patterns can be provided with the aid of which the organic electroluminescent display device is composed. Such layers and layer patterns comprise, for instance, a PDOT- and PPV- layer in the pixel pits or sub-pixel pits, insulating layers for covering the first conductor and conductive layers for forming a number of second conductors.

According to a further elaboration of the invention, optionally, with a curing varnish, an additional relief structure can be applied to the substrate already provided with a number of layers, for forming a relief structure desired for the application of a following layer. For instance, in a simple manner, a number of new channels can be formed in which the liquid, forming the second conductors, can be deposited. This curing varnish can for instance be a UV-curing varnish which is deposited locally with an inkjet printing operation. In such a manner, for instance, also the above-described shadowing structure can be removed by filling the relatively narrow and deep grooves up with UV-curing varnish.

According to an alternative, further elaboration of the invention, after application of at least one layer, the shape of the surface structure can be adapted through a transforming technique, such as, for instance, a local thermal treatment. Such a thermal treatment can, for instance, be

contactlessly, via infrared radiation, or laser irradiation or with a contact treatment. Thus, for instance, the groove-shaped shadowing structures can be melted away.

According to the invention, the substrate described in the opening paragraph is characterized in that it is manufactured from plastic and has a surface structure which forms a boundary for at least for a number of the layers to be applied in the method, the surface structure of plastic substrate being provided with a shadowing structure which is such that with the layer application process, parts of this shadowing structure are hardly covered, if at all, with the respective conductive layer, the shadowing structure being such that the electrical resistance prevailing there is great relative to the resistance in the rest of the conductive layer.

Such a plastic substrate provided with a surface structure can be manufactured in one single operation in an injection molding process. This means that the cost price of the substrate can be particularly low. This in contrast with the substrates from glass used heretofore, on which, with the aid of photochemical techniques, structures have been applied.

According to a further elaboration of the invention, the surface structure can comprise a number of pixel pits or sub-pixel pits. Such pits render the deposition of liquid therein, such as for instance PDOT or PPV, with the aid of an inkjet process simple and more controllable.

Further, the surface structure can comprise a shadowing structure which is such that with a sputtering process, indirect sputtering and/or evaporation, parts of this shadowing structure are not covered with the respective conductive layer, so that the shadowing structure forms insulating tracks in the conductive layer. According to a further elaboration of the invention, the shadowing structure can be formed by a number of parallel narrow and deep grooves, while the width and the depth of the grooves is such that at least a part of the side walls and/or the bottom of these grooves are not covered with a first conductive layer in a sputtering process.

According to still a further elaboration of the invention, in the pixel pits or sub-pixel pits, a structure can be provided which influences the generated light that passes the structure. Such a structure can also be provided at the side of the substrate remote from the pixel pits or sub-pixel pits. For instance, a structure in the form of a Fresnel lens, having a converging or diverging effect on the light passing through the structure, can be considered.

Further, according to a further elaboration of the invention, in the pixel pits or sub-pixel pits, a structure can be provided which is designed for improving the distribution of liquid for forming the layers applied in the pixel pits or sub-pixel pits. It is noted that such structures, improving the distribution of liquid, can also be provided in the channels in which, through printing techniques, liquids are deposited, for a better distribution of the liquid.

According to a further elaboration of the invention, a contact surface enlarging structure can be provided in the pixel pits or sub-pixel pits. Firstly, such a contact surface enlarging structure yields a larger conductive surface so that the electrical resistance across a pixel is reduced. Moreover, a larger electroluminescent surface is created so that a greater light intensity per pixel is obtained. Optionally, the structure improving the distribution of liquid can also be combined with the contact surface enlarging structure. The structure can, for instance, comprise a number of capillary grooves.

The invention also provides an organic electroluminescent display device manufactured while using a method according to any one of claims 1 - 30 starting from a substrate according to any one of claims 31 – 44.

Figs. 1 – 18 show the various steps of building up a first embodiment of a display device according to the invention while the Figures with the uneven Figure numbers show cross-sectional views and the Figures with even Figure numbers show top plan views;

Figs. 19 – 36 show the various steps of building up a second embodiment of a display device according to the invention, while the Figures with uneven Figure numbers show cross-sectional views and the Figures with even Figure numbers show top plan views;

Fig. 37 shows a top plan view of the substrate, wherein a first structure which has been applied in a pixel pit is shown;

Fig. 38 shows a top plan view of the substrate, wherein a second structure which has been applied in a pixel put is shown;

Fig. 39a shows a substrate with a shadowing structure provided therein; and

Fig. 39b shows in which manner this shadowing structure can be locally removed through a thermal laser operation.

Figs. 1 and 2 show a cross-sectional front view and a top plan view of a part of a plastic substrate 1 not yet provided with layers for manufacturing an organic electroluminescent display device. During the manufacture of the substrate, for instance with the aid of an injection molding operation, the substrate has been provided with a surface structure forming a boundary, at least for a number of the layers to be applied. For instance, pixel pits 2 are clearly visible which are bounded by pixel pit boundaries 3. The surface structure further comprises a shadowing structure 4. In the present exemplary embodiment, the shadowing structure has been designed as, each time, a number of parallel, deep, narrow grooves 4', 4", 4"'. Such a shadowing structure is such that a layer to be applied with a layer application process such as, for instance, sputtering, hardly covers, if at all, parts of the shadowing structure.

Figs. 3 and 4 shows the same substrate which is provided with a transparent encapsulation layer 5, such as, for instance, a nitride-oxide-nitride-, or, NON-layer. Also, other transparent layers which are tight to water, oxygen and other undesired substances are among the possibilities. The

transparent encapsulation layer can, for instance, be applied with a deposition technique such as a PVD-, CVD- or PECVD-process.

Figs. 5 and 6 show the substrate after a first conductive layer 6 has been applied. Such layers can be applied with, for instance, a sputtering process. In the present exemplary embodiment, the first conductive layer is formed by a TCO-layer (transparent conductive oxide). Also, other conductive layers can be applied. It is clearly visible that the deep parts of the grooves 4', 4", 4'" are hardly covered, if at all, with the first conductive layer 6. In this manner therefore, parallel conductive paths are obtained insulated from each other and extending in a first direction. The Figures also clearly show that parts of the first conductors extend in pixel pits or sub-pixel pits 2 of the surface structure of the substrate 1. The first conductive layer can also be a so-called PDOT-layer. However, it is also possible that a hole injecting layer 7, such as, for instance, a PDOT-layer is applied exclusively in the pixel pits or sub-pixel pits 2. With this last-mentioned option, which is represented in Figs. 7 and 8, the layer can for instance be deposited in the pixel pits or sub-pixel pits with a printing operation, such as for instance an inkjet operation. Since the pixel pits or sub-pixel pits 2 are bounded by pixel pit boundaries 3, the risk of the liquid forming the PDOT-layer flowing outside the pixel pits or sub-pixel pits 2 is reduced to a minimum.

Thereupon, in Figs. 9 and 10, it is shown that in the pixel pits or sub-pixel pits 2, further, a light emitting layer 8 is deposited, such as, for instance, a PPV-layer. This layer too can be provided with the aid of, for instance, inkjet printing.

Figs. 11 and 12 show that the shadowing structure 4 and, more in particular, the deep, narrow grooves 4', 4", 4'" are filled up with an insulating covering 9. This covering can for instance be formed by a UV-curing varnish which can be accurately applied with the aid of an inkjet printing operation. Instead thereof, the method represented in Fig. 39b can also be used.

Then, as shown in Figs. 13 and 14, the entire substrate 1 is covered with a layer of barium 10, whereupon, as shown in Figs. 15 and 16, a second conductive layer 11 is applied such that a number of parallel conductors 12 is provided, extending in a second direction and which are mutually insulated from each other. Parts of the second conductors 12 extend in pixel pits or sub-pixel pits 2 of the surface structure of the substrate 1. In the present exemplary embodiment, the second conductors 12 extend perpendicularly to the first conductors which extend between the parallel shadowing structures 4. The second conductive layer 11 too can be selectively applied with the aid of a printing process, such as for instance an inkjet printing operation.

Finally, Figs. 17 and 18 show that a second encapsulation layer 13 is applied over the entire substrate. This layer too seals off from undesired substances, such as, for instance, water, oxygen and the like.

Figs. 19 and 20 show a second embodiment of a substrate 21. In contrast to the first exemplary embodiment, this substrate has not been provided with a shadowing structure as described hereinabove. Instead thereof, a channel structure 24 with channel boundary 24' is present for a printable first conductive layer. Also, the pixel pits or sub-pixel pits 22 are clearly visible with the pixel pit boundaries 23. Further, a separating structure 25 is already partially present for a printable second conductive layer. This separating structure 25 is still interrupted at the location of the channels 24 in which the first conductive layer 27 is to be printed.

Figs. 21 and 22 show the same substrate which is provided with a transparent encapsulation layer 26, such as, for instance, nitride-oxide-nitride, or NON-layer. Also, other transparent layers which are tight to water, oxygen and other undesired substances are among the possibilities. The transparent encapsulation layer 26 can, for instance, be applied through an evaporation technique such as a CVD- or PECVD-process.

Figs. 23 and 24 show a printed first conductive layer 27. It is clearly visible that the first conductive layer 27 extends in the channel structure 24

intended thereto and in the pixel pits or sub-pixel pits 12. In the present exemplary embodiment, the first conductive layer 27 is formed by a PDOT-layer which has been provided on the desired location with the aid of an inkjet printing operation. The channel structure boundary 24' and the pixel pit boundary 23 ensure that the liquid does not flow outside the desired areas.

Figs. 25 and 26 show that in the pixel pits or sub-pixel pits 22, further, a light emitting layer 28 is deposited, such as, for instance, a PPV-layer. This layer 28 too can be provided with for instance inkjet printing.

In Figs. 27 and 28 it is shown that across the channel structure 24, an insulating covering 29 has been provided. The insulating covering 29 can for instance be formed by a UV-varnish or photoresist varnish.

Figs. 29 and 30 show that the separating structure 25 has also been provided in the channel structure 24 through the provision of a threshold 30 therein. The additional relief structure is therefore provided on the substrate already provided with a number of layers for forming a relief structure desired for applying a following layer. In the present exemplary embodiment, the additional relief structure 30 is provided with the aid of a printing operation, while using a curing varnish, for instance a UV-curing varnish. Thus, channels 31 are formed, extending parallel to each other, while the channel direction is perpendicular to the first direction mentioned in which the first conductors 27 extend.

Figs. 31 and 32 show that, thereupon, the entire substrate is covered with an electron injecting layer 32 such as, for instance, a calcium-, magnesium-, lithium fluoride- or barium-layer.

Subsequently, Figs. 33 and 34 show that the second conductive layer 33 has been provided in the channels 31, for instance with the aid of an inkjet printing operation. The second conductive layer 33 provides a number of parallel conductors, mutually insulated from each other and extending in the second direction, while parts of the second conductors extend in pixel pits or sub-pixel pits 22 of the surface structure of the substrate 21.

Finally, Figs. 35 and 36 show that after the application of the second conductive layer, an encapsulation layer 34 is applied over substantially the entire surface of the substrate. This layer too seals off from undesired substances such as, for instance, water, oxygen and the like. The layer can comprise, for instance, a Nitride-metal-Nitride layer, a NONON-layer or a NDLCN-layer (nitrido diamond like carbon nitride).

Fig. 37 shows a top plan view of a substrate wherein, in the pixel pits or sub-pixel pits, a structure 35 has been provided which influences the generated light passing the structure. In Fig. 37, the structure forms a Fresnel lens 35 which has a converging, diverging or, conversely, paralleling effect. It is noted that such a structure can also extend over several pixels, so that in a part of the eventual display, the issuing light is optically influenced. Such a structure can also be provided on the side of the substrate remote from the pixel pits.

Fig. 38 shows another structure 36 provided in the pixel pits or sub-pixel pits 2, 22, designed to improve the distribution of liquid for forming layers provided in the pixel pits or sub-pixel pits. Preferably, this structure 36 also has a contact surface enlarging effect. This can, for instance, be effected with a structure which is provided with capillary grooves. Such a larger contact surface not only reduces the electrical resistance, it also provides a larger light emitting surface, so that, also, more light is generated.

Figs. 39a shows, in cross section, once more, a substrate 1 with a shadowing structure 4. In Fig. 39b, it is shown how this structure can be melted away locally with the aid of a laser beam or infrared beam directed through a lens 37, which locally heats the shadowing structure 4 such that it melts, so that the shadowing structure 4 disappears.

It is clear that the invention is not limited to the exemplary embodiments described but that various modifications are possible within the framework of the invention as defined in the claims.

Claims

1. A method for manufacturing an organic electroluminescent display device, wherein an arrangement of layers is applied to a substrate such, that in a first direction, first conductors extend as well as second conductors in a second direction, while between crossings of the first and second conductors an organic electroluminescent compound has been provided which, under the influence of a voltage, emits light, the substrate being manufactured from plastic and having a surface structure which forms a boundary for at least a number of the layers which are applied, a first conductive layer being applied by means of a layer application process, the surface structure of plastic substrate being provided with a shadowing structure which is such that with the layer application process, parts of this shadowing structure are hardly covered, if at all, with the respective conductive layer, the shadowing structure being such that the electrical resistance prevailing there is great relative to the resistance in the rest of the conductive layer.

2. A method according to claim 1, wherein the manufacture of the substrate takes place with the aid of an injection molding process.

3. A method according to claim 2, wherein in the injection molding process use is made of an injection molding mold which is provided with a negative image of the desired surface structure of the substrate.

4. A method according to claim 1, wherein the manufacture of the substrate takes place with the aid of embossing, photopolymeric replication or a similar plastic formation process.

5. A method according to any one of the preceding claims, wherein after the manufacture of the plastic substrate, a first transparent encapsulation layer is applied to the substrate.

6. A method according to claim 5, wherein the first transparent encapsulation layer is a nitride-oxide-nitride layer (NON-layer).

7. A method according to claim 5 or 6, wherein this first transparent encapsulation layer is applied with the aid of a deposition technique, such as, for instance, a PVD-, CVD- or PECVD-process.

8. A method according to any one of claims 5 – 7, wherein after the application of the first transparent encapsulation layer, a first conductive layer is applied such that a number of parallel conductors extending in a first direction is provided which are mutually insulated from each other, while parts of the first conductors extend in pixel pits or sub-pixel pits of the surface structure of the substrate.

9. A method according to claim 8, wherein the layer application process for the first conductive layer is a sputtering process.

10. A method according to claim 9, wherein the shadowing structure comprises a number of parallel, narrow and deep grooves, the width and the depth of the grooves being such that at least a part of the side walls and/or the bottom of these grooves are hardly covered, if at all, with the first conductive layer in the sputtering process.

11. A method according to claim 8, wherein the first conductive layer is applied with the aid of a printing operation, such as for instance inkjet printing, silkscreen printing, electrostatic printing or thermal transfer printing.

12. A method according to any one of claims 8 – 11, wherein after the application of the first conductive layer, at least in the pixel pits or sub-pixel pits, a hole injecting layer such as for instance a PDOT-layer is applied.

13. A method according to claim 11, wherein the first conductive layer also forms a hole injecting layer in the pixel pits or sub-pixel pits, such as for instance a PDOT-layer.

14. A method according to any one of claims 12 or 13, wherein after application of the hole injecting layer a light emitting light is provided locally in at least the pixel pits or sub-pixel pits, such as for instance a PPV-layer.

15. A method according to at least claim 8, wherein at least those parts of the first conductive layer which are not covered with a light emitting layer and which, in a following process step, will be covered by a second conductive layer, are provided with an insulating covering prior to said following process step.

16. A method according to claim 15, wherein the insulating covering is applied with a printing operation, such as, for instance, by means of inkjet printing.

17. A method according to claim 16, wherein the insulating layer is formed from a UV-curing varnish.

18. A method according to claims 10 and 16 or claims 10 and 17, wherein the deep grooves forming the shadowing structure are filled up with the insulating covering.

19. A method according to any one of the preceding claims, wherein the shape of the surface structure, after application of at least one layer, is adapted by a transforming technique, such as, for instance, a local thermal treatment.

20. A method according to claim 19, wherein the local thermal treatment is carried out with the aid of a laser operation or with the aid of a local infrared irradiation.

21. A method according to any one of the preceding claims, wherein an additional relief structure is provided on the substrate already provided with a number of layers, for forming a relief structure desired for the application of a following layer.

22. A method according to claim 21, wherein the additional relief structure is provided with the aid of a printing operation, while using a curing varnish, preferably a UV-curing varnish.

23. A method according to claims 8 and 21 or claims 8 and 22, wherein after application of the insulator, a relief structure is provided for forming

channels extending parallel to each other, while the channel direction is perpendicular to said first direction in which the first conductors extend.

24. A method according to claim 15, wherein after application of the insulating covering, a second conductive layer is provided such that in simple manner, a number of parallel conductors are provided extending in a second direction and which are mutually insulated from each other, while parts of the second conductors extend in pixel pits or sub-pixel pits of the surface structure of the substrate.

25. A method according to claim 24, wherein the second direction is perpendicular to the first direction.

26. A method according to claim 24 or 25, wherein the second conductive layer is applied with a printing process, such as, for instance, inkjet printing, silkscreen printing, electrostatic printing or thermal transfer printing.

27. A method according to claim 23 and any one of claims 24 – 26, wherein the second conductive layer is applied in said channels extending parallel to each other.

28. A method according to any one of claims 24 – 27, wherein, prior to the application of the second conductive layer and after the application of the insulating covering, an electron injecting layer such as a calcium, magnesium, lithium fluoride or barium layer is applied to the substrate.

29. A method according to claim 28, wherein the barium layer is applied with a PVD-process.

30. A method according to any one of claims 24 – 27, wherein after the application of the second conductive layer at least one encapsulation layer is applied.

31. A substrate suitable and intended for use in a method according to any one of the preceding claims for manufacturing an organic electroluminescent display device, the method comprising the step of applying a first conductive layer by means of a layer application process, wherein the substrate has been manufactured from plastic and has a surface structure

forming a boundary for at least a number of the layers to be applied, the surface structure of plastic substrate being provided with a shadowing structure which is such that with the layer application process, parts of this shadowing structure are hardly covered, if at all, with the respective conductive layer, the shadowing structure being such that the electrical resistance prevailing there is great relative to the resistance in the rest of the conductive layer.

32. A substrate according to claim 31, wherein the surface structure comprises a number of pixel pits or sub-pixel pits.

33. A substrate according to claim 31 or 32, wherein the surface structure comprises a shadowing structure which is such that with a sputtering process, parts of this shadowing structure are not covered with the respective conductive layer.

34. A substrate according to claim 33, wherein the shadowing structure comprises a number of parallel, narrow and deep grooves, wherein the width and the depth of the grooves is such that at least a part of the side walls and/or the bottom of these grooves are not covered with the first conductive layer in the sputtering process.

35. A substrate according to any one of claims 31 – 34, wherein the surface structure is releasing such that it can be taken from a mold which is provided with a negative image of the surface structure.

36. A substrate according to any one of claims 31 – 35, wherein the substrate is an injection molding product.

37. A substrate according to any one of claims 31 – 36, wherein, in the pixel pits or sub-pixel pits, a structure has been provided which influences the generated light passing the structure.

38. A substrate according to any one of claims 31 – 36, wherein at the side of the substrate remote from the pixel pits or sub-pixel pits, a structure has been provided which influences the generated light passing the structure.

39. A substrate according to claim 37 or 38, wherein the structure comprises a Fresnel lens.

40. A substrate according to any one of claims 37 – 39, wherein the structure has a converging effect on the light issuing through the structure.

41. A substrate according to any one of claims 37 – 39, wherein the structure has a diverging effect on the light issuing through the structure.

42. A substrate according to any one of claims 31 – 41, wherein in the pixel pits or sub-pixel pits a structure has been provided, designed for improving the distribution of liquid for forming the layers provided in the pixel pits or substantially- pixel pits.

43. A substrate according to any one of claims 31 – 42, wherein in the pixel pits or sub-pixel pits a contact surface enlarging structure has been provided.

44. A substrate according to any one of claims 42 or 43, wherein the structure comprises capillary grooves.

45. An organic electroluminescent display device manufactured while using a method according to any one of claims 1 – 30 starting from a substrate according to any one of claims 31 – 44.

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